

35. Some Brackish-water Amphipoda from the mouths of the Weser and the Elbe, and from the Baltic\*. By E. W. SEXTON, Marine Biological Laboratory, Plymouth†.

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(Plates LXXIII. & LXXIV.‡)

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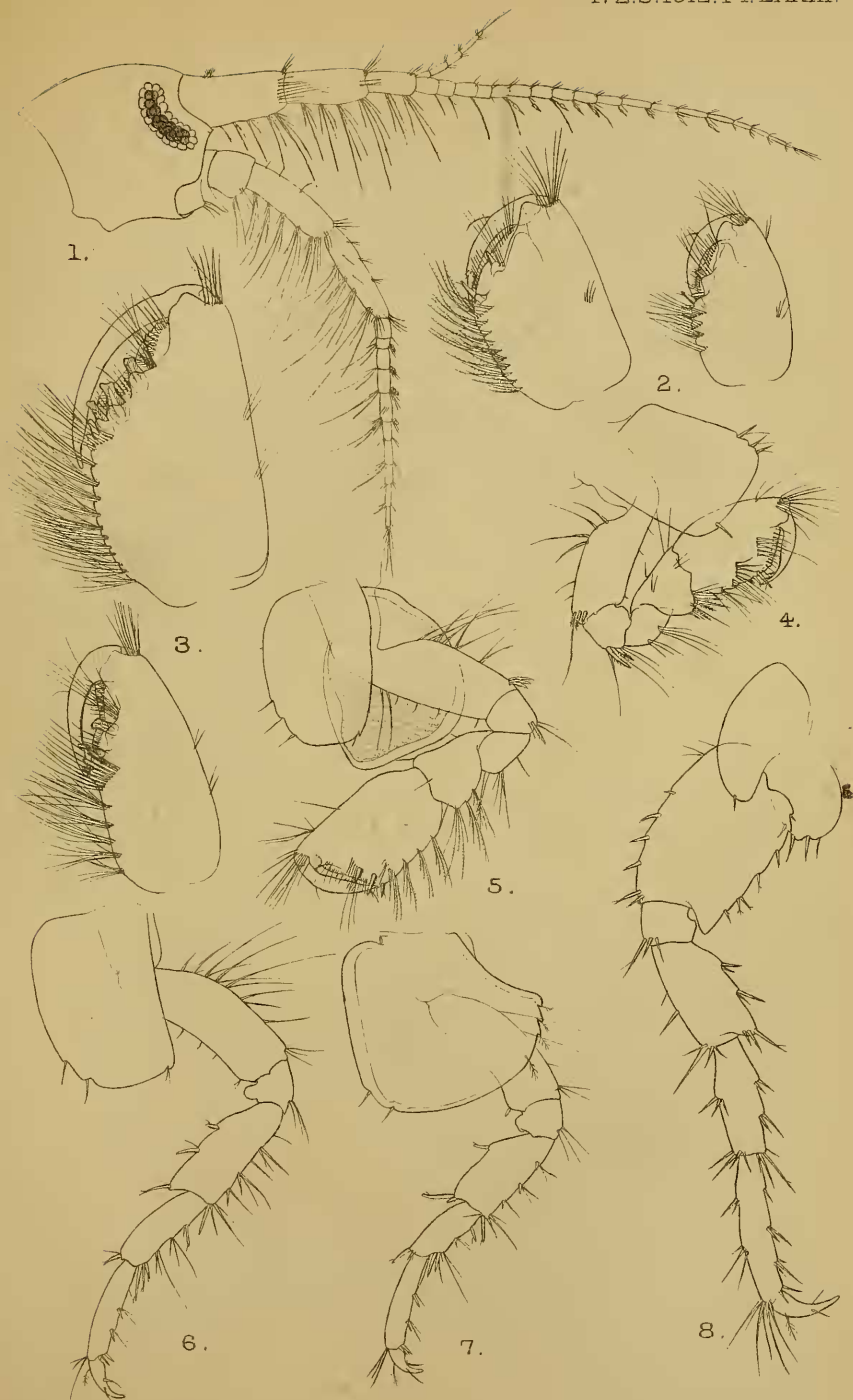
While engaged in determining the Copepoda of the harbour at Bremerhaven, Herr W. Klie met with certain Gammaridea, some of which were not easily referable to known forms. Through the intervention of a friend these were submitted to me for examination, and the present paper contains the result, with notes on some other collections of brackish-water *Gammarus*. There proved to be three species in Herr Klie's collection, one of them (*Leptocheirus pilosus* Zaddach) already known, the other two apparently new, which I described. But before the description was published I received a paper from Dr. Vanhöffen, which contained the description and figures of one of these species under the name of *Corophium lacustre*. I have therefore included here only a few notes on this species. Dr. Vanhöffen kindly allowed me to examine his specimens of Amphipoda from the Frische Haff, and it is interesting to note that the three species, *Leptocheirus pilosus* Zadd., *Corophium lacustre* Vanhöffen, and *Gammarus zaddachi*, sp. n., are present in both his and Herr Klie's collections. All three appear to flourish equally well in absolutely fresh water as in the brackish water of river estuaries and harbour basins.

The classification of the Amphipoda is rendered exceedingly difficult by the changes or modifications resulting from each successive moult. We know practically nothing yet of the factors influencing the development of any given species, except those of *growth* and *sex*. The modifications caused by these two alone are responsible for an excessive multiplication of synonyms; in some cases, *Jassa* for instance, almost every moult has been given a different specific and sometimes a different generic name by different observers. But in the species of *Gammarus*

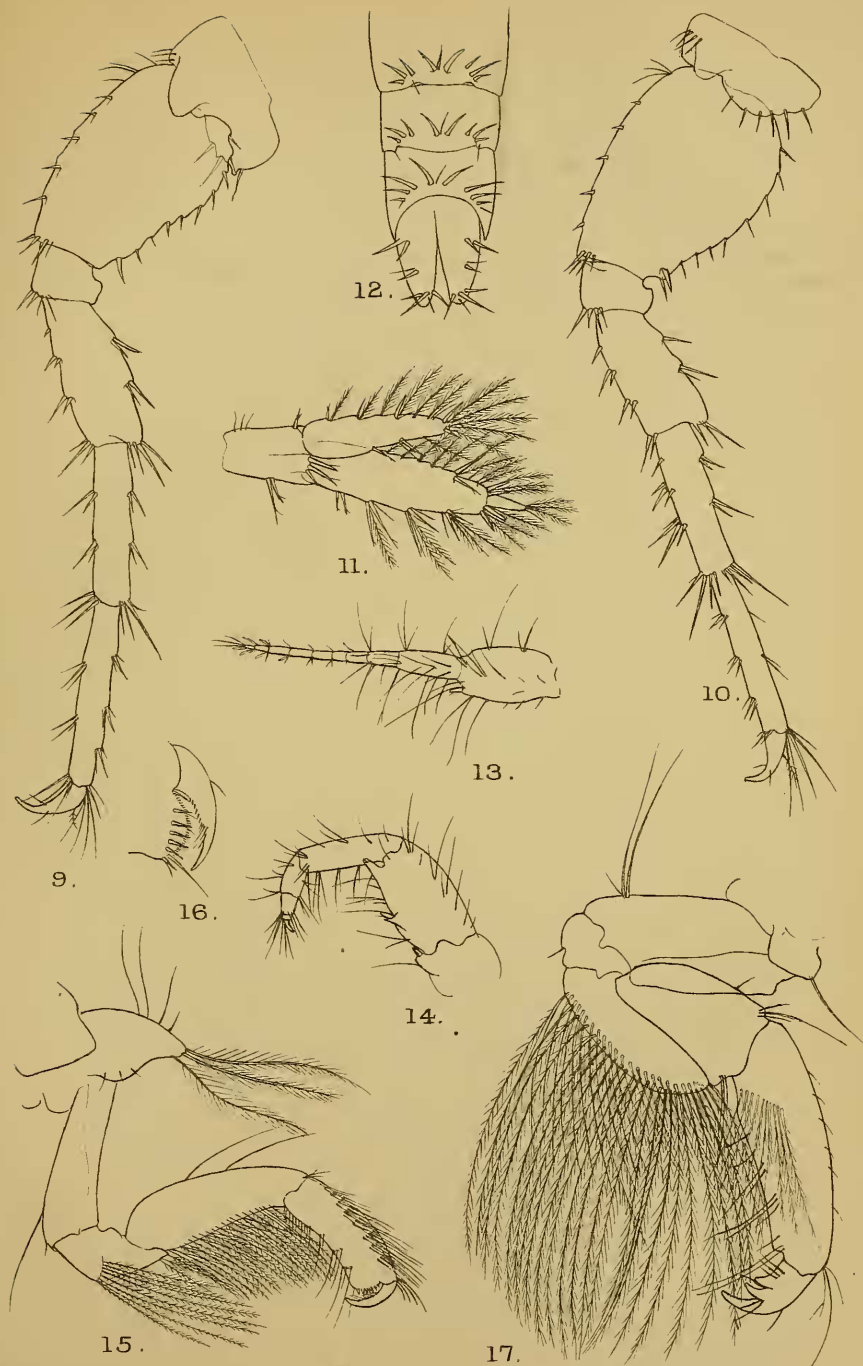
\* [Since this paper was communicated to the Society, under the title "Some Amphipoda from Bremerhaven," the author received some large collections of the *Gammarus* described, which showed remarkable differences between those living in salt and in fresh water. These facts have been included in the text, and the title has been slightly modified.]—ED. P. Z. S.

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‡ For explanation of the Plates see p. 665.







E.W.Sexton del.

Huth sc. et imp.

AMPHIPODA FROM BREMERHAVEN.



described below, certain marked modifications occur which cannot be referred to either of these influences. They would appear to be caused by the animal's environment, according as it lives in fresh water or in salt. The difference in appearance between a typical adult freshwater specimen and a typical marine or brackish-water one is so extreme as to suggest their belonging to distinct species, but structurally they are identical, and intermediate forms are very common (see below, "Moorflether Concave"), apparently varying with the degree of salinity, though on this point I cannot as yet speak definitely. Experiments have been instituted at the Laboratory here with an allied species to try and determine the question of the effect of salinity on the animal and the length of time for such effect to become evident.

GAMMARUS ZADDACHI, sp. n. (Pls. LXXIII. & LXXIV. figs. 1-12.)

=1844. *Gammarus locusta* Fabr. ?, Zaddach, Syn. Crust. Pruss. p. 4.

=1878. *Gammarus locusta* Fabr., Zaddach, Die Meeres Fauna an der preussischen Küste, pp. 26-32.

=1886. *Gammarus pulex* Kraepelin, Die Fauna der Hamburger Wasserleitung. Abhand. Geb. d. Naturw. Verein in Hamburg, Bd. ix. H. 1.

=1907. *Gammarus pulex* Volk, Mitteil. biol. Elbeuntersuchung. Naturh. Museums in Hamburg. Verhandl. Naturw. Ver. Hamburg.

=1911. *Gammarus locusta* L., Vanhöffen, Beiträge z. Kennt. d. Brackwasserfauna im Frischen Haff. Sitzung. d. Gesellsch. naturf. Freunde, Berlin, 1911, no. 9.

It is with reluctance that I have felt myself obliged to institute a new species in the already overcrowded and confused genus *Gammarus*. The species of *Gammarus* are difficult to separate except by the secondary sexual characters of the adult males; the immature of all the species are practically indistinguishable from each other, and even the females are not easy to differentiate. The species now under discussion has been frequently confounded with others, the freshwater form with *G. pulex*, and the marine and brackish-water form with *G. locusta* and *G. duebenii*; but it can be distinguished from them by a glance at the antennæ, both of which are characterised by clusters of long outstanding hairs, and by the form of the 4th sideplate and the 3rd uropod.

The brackish-water specimens are characterised by their slenderness and transparency, and the tenuity of their epidermis, while the freshwater ones are broad, very robustly built, the epidermis thick, strong and opaque, the basal joints of the hinder peræopods narrower especially in the old males, and with a much denser supply of the long fine hairs developed on the antennæ, the peræopods, particularly the hinder ones, the pleon, the 3rd

uropods, and the telson; in some cases these long hairs appear to replace the spines of the brackish-water form, *e. g.* those inset on the inferior margins of the 2nd and 3rd pleon epimera and the posterior margins of the 4th and 5th pereopods.

The finest brackish-water specimens I have seen come from the Königsberg Collection, taken at Rauschen and Zoppot, the largest freshwater ones from the Hamburg "Wasserleitung." These are larger than any of the others examined by me, probably owing to the more protected life they lead in the underground pipes, and the rich and constant supply of food.

The collections I have examined are as follows, with the names of those to whom I am greatly indebted for the opportunity of so doing:—

1. *Königsberg Museum*: Dr. Lühe. Four tubes containing Zaddach's specimens and others from Danzig Bucht, Zoppot, Koliebk, Redlan, and Rauschen, in all about 125. Most of the specimens are of the typical brackish-water form, but in one sample from Danzig in which a specimen of the freshwater *G. pulex* was also found, many of the animals were "intermediate" forms, more solidly built and with the long fine hairs developed in great numbers.

2. *Frisches Haff*: Dr. Vanhöffen. Two tubes labelled "Gammarus locusta L. Frisches Haff bei Pillau Ostpreussen. 20.ix.1911. Vanhöffen. 5." One tube contained 16 specimens, 2-5.5 mm. in length. It is interesting to note a few young *Leptocheirus pilosus* with the young *G. zaddachi*; these two species, with *Corophium volutator* and *C. lacustre*, seem to flourish equally well in fresh or brackish water and are frequently recorded together. There were 8 specimens of *G. zaddachi* in the second tube, 3.5-10 mm. long, all of the brackish-water form; the largest, however, approaching the freshwater form, strongly built and opaque.

3. *Mouth of the Oder*: Dr. Vanhöffen. One tube, "Gammarus locusta L. Dievenow Odermündung Pommern 1889. Hilgen-dorf. 5." 26 specimens, 1 young male *G. locusta* and 25 *G. zaddachi* exactly like those described from Pillau.

4. *Mouth of the Elbe*, from Schulau to Gauert, together with a collection from the *Hamburg Wasserleitung*; Dr. Steinhaus. This is a most interesting series taken at regular stations in the Elbe (see Volk, with map of the district), containing in all about 500 specimens. Commencing with the stations nearest the mouth of the river, where the water has nearly the full salinity of the North Sea, the details are as follows:—

"Süder-Elbe südl. Blankanese. Grund. 11.vi.00." 11 specimens 4-10 mm.

"Hafen südl. Nienstedten. Grund. 2.vi.00." 35 specimens 1.5-10 mm.

"Hafen südl. Nienstedten. 11.vi.00." 3 specimens, largest a female 11 mm.

"Linkes Elb-Ufer südl. Nienstedten. 2.ix.00." 3 specimens, largest a female 8 mm.



"Altona. Ponton. 9.vii.00." 107 specimens, all rather small, averaging 8-9 mm. in length; the eyes in these have reddish-brown pigment.

"Altona. Duc d'Alben. 1.x.00." 1 specimen, a female.

All these belong indubitably to the brackish-water type. The very young animals differ slightly from the adult, the eyes are round, the peduncles of the antennæ are about equal in length, the pleon clusters are represented each by a single spine, and the rami of the third uropod are much more unequal than in the adult. Some of the specimens, especially those from Blankanese, are more setose than the others.

"Hamburg." The "Fleet" referred to is one of the canals which run through the inner town. These canals are mostly dependent on the tide, with mud-banks exposed at low tide. "Grasbrokhafen" and "Indiahafen" are blind alleys as it were opening out of the Harbour basin; they are deep and broad, the bottom consisting of clay, sand and mud, with organic detritus deposits providing food for a rich animal life.

"Fleet 1. Grund. 25.vi.00." 1 specimen, a male 11 mm.

"Fleet 1. Krotzprobe. 23.vii.00." 1 specimen, a male, with exceptionally large eyes.

"Grasbrookhafen. Grund. 19.xi.00." 2 specimens 19-20 mm.

"Grasbrookhafen. Duc d'Alben. 20.vi.00." 18 specimens mostly small, the largest 9-10 mm.

"Indiahafen. Ponton. Oberfläche. 22.v.00." 77 specimens, all very young.

The specimens from the "Fleet" samples show intermediate characters, forming the link between the two extremes of the species. They are more solid in appearance than the brackish-water form, but the chitin is not as thick as in the freshwater animal. The spines and long hairs vary greatly in number, and the narrowing of the basal joints of the hinder peræopods also appears variable. Of the "Grasbrookhafen" specimens the two from the bottom are typical freshwater ones; the eighteen specimens from the "Duc d'Alben" (piles driven in and used for making ships fast) are all delicate in appearance, the largest showing intermediate characters. Some of the small ones, 3-4 mm. long, are extremely slender and compressed, almost thread-like, and with very few hairs. The "Indiahafen" specimens are all very small, the brackish-water form.

"Alte Dove Elbe and Moorflether Concave." Volk says of these that, taken together, they form a quiet bay with the biological characters of a backwater ("Altwasser"), but influenced to some degree by the tide. These samples are the most interesting of the series; in some both the fresh- and the brackish-water forms occur together, with the "intermediate" form.

"Moorflether Concave. Grund I. 23.vii.00." 1 specimen, a female 9 mm., with the delicate appearance of the brackish-water form, but with dense clusters of long hairs on antennæ, peræopods, and telson.



"Moorflether Concave. Oberfläche II. 23.vii.00." 11 specimens; the largest, males, measured 10-11 mm.; all the brackish-water form.

"Moorflether Concave. 23.viii.00." 129 specimens; largest 15 mm. Freshwater, brackish, and "intermediate" forms, and one specimen of the exceedingly narrow, thread-like form described from the Grasbrookhafen sample.

"Moorflether Concave. Ponton. 23.viii.00." 5 specimens, the largest, a male of 14 mm., shows the freshwater characters; the others are of the brackish-water type.

"Moorflether Concave. 24.ix.00." 37 specimens, brackish-water form, largest 12 mm.

The three following samples are all unmistakable brackish-water form. The "Prielen" are little channels cut in the banks of the river; the current is less strong, and the growth of vegetation and animal life richer than in the Elbe.

"Dove Elbe. Oberfl. 2.vii.00." 6 specimens, largest about 8 mm.

"I. P. r. O. 7.vi.00" (= Rechtsseitiger Elbpriel am Spadenland, Oberfläche). 6 specimens, largest 10 mm.

"I. P. r. O. 2.vii.00." 14 specimens, largest 8 mm.

The remaining samples are all fine examples of the typical freshwater form.

"Kaltenhofe. 'Wasserprobe aus Filter No. 16 entnommen am 6. Dec. 1894.'" 3 specimens, the largest 22 mm.

"Hamburger Wasserleitung." 5 specimens, 18-20 mm. long.

"Hamburger Wasserleitung. Samuelson." 71 specimens. Dr. Kraepelin has given a very interesting account of the conditions of animal life in the underground "Wasserleitung" of Hamburg, conditions much more favourable than in the Elbe, owing to the greater abundance of food, the protection from many enemies, and the lesser temperature variations. He mentions this species under the name of *G. pulex* as second only in numbers to *Asellus aquaticus* among the Edriophthalma met with in the series of samples taken.

5. *Bremerhaven*: Herr Klie. One tube "Alter Hafen. x.11." 10 specimens, the largest a female 9 mm., from which several of the figures are drawn. This sample contains one of the thread-like form described above. These Bremerhaven specimens, which come from saltier water than the preceding, have scarcely any of the long fine hairs developed, which so strikingly characterise the freshwater animals.

6. *Irish Lakes*: British Museum (coll. by Major Trevelyan).

"Lough Nadarragh." 4 large specimens, male and female, about 18 mm. in length. Freshwater form, exactly like those from the Hamburg Wasserleitung.

"Lough Keenaghan." 2 specimens, male and female *G. pulex*.

"Lough Keenaghan." 1 specimen, a female, freshwater form, *G. zaddachi*.

"Lough Awaddy and Tullynabour." 4 specimens, three males and one female, largest 14-15 mm. Freshwater form.

"Lough Erne." 4 specimens; two *G. zaddachi*, male and female, freshwater form; and two *G. pulex*.

The first to observe the species now under discussion was Zaddach, after whom I have accordingly named it.

In 1844 he described it under the name of "*Gammarus locusta* Fabr.?", but pointed out the characters in which it differed from Milne-Edwards's description, adding that if the latter were correct, his (Zaddach's) species must be regarded as new. In his later work he gives a more detailed description and figures of the species, again, however, emphasizing the differences in the antennæ and the 3rd uropods. Zaddach's specimens are still preserved at Königsberg Museum. The *G. locusta*, described by Chevreux (Bull. Soc. Zool. v. xvii. p. 141) as inhabiting the Loire and the mouths of rivers of Corsica and Provence, is very probably the species here described.

The principal points of difference between this newly-established species and *G. locusta* lie in the antennæ, in the proportions of the peduncle-joints of antenna 1, and in the setæ, in the gnathopoda, in the 4th side-plate, in the armature of the pleon, and in the 3rd uropod.

It differs from *G. duebenii*, specimens of which were kindly sent to me by Professor Sars for comparison, in the following points:—The upper antenna of *G. duebenii* is only sparsely furnished with hairs, and has none of the regular graduated clusters so characteristic of *G. zaddachi*; the hands of gnaths. 1 and 2 are smaller, and practically subequal in size, in *G. zaddachi* the hand of gnath. 2 is decidedly larger than that of gnath. 1; in the adult *G. duebenii* the basal joints of peræopods 3, 4, and 5 are all expanded, with the hind corners free, while in *G. zaddachi* these joints are hardly expanded at all in the male, and only the 3rd has the hind corner free; in the largest *G. duebenii* the 1st and 2nd uropods and the telson reach to the level of the peduncle of uropod 3, and the outer ramus of urop. 3 is twice the length of the outer ramus of urop. 1 (in the smaller specimens the proportions are as figured by Sars, Crust. Norway, vol. i. pl. 177); in *G. zaddachi* urop. 1 is considerably longer than urop. 2, and the outer ramus of urop. 3 only half as long again as that of urop. 1; the telson in *G. duebenii* is shorter, broader, and more spinose.

From *G. pulex* it is distinguished at once by the shape of the eye, small and rounded in *G. pulex*, large and reniform in *G. zaddachi*; the antennæ, gnathopods, 4th sideplate, pleon armature, and the 3rd uropods also differ.

The Bremerhaven and Frisches Haff specimens are all young, the largest, a female figured on Pl. LXXIII., measuring 9 mm. The largest male in the Königsberg collection measures 18.5 mm.; the females are much smaller and broader, 12-13 mm., but none